APPENDIX D

District BART Determination

This page intentionally left blank.

BAY AREA
AIR QUALITY
MANAGEMENT
DISTRICT
SINCE 1955

November 6, 2008

Ms. Lynn Terry
Deputy Executive Officer
California Air Resources Board
1001 "I" Street
P.O. Box 2815
Sacramento, California 95812

Dear Ms. Terry:

As you know, Bay Area Air Quality Management District staff has been working on addressing the requirement of Best Available Retrofit Technology (BART) for certain existing sources within our jurisdiction. BART is one of the principle elements of federal regional haze regulations, and your staff will be including the necessary BART determinations in the State Implementation Plan (SIP) that addresses visibility protection requirements.

We have enclosed our BART determination for the Bay Area sources that your staff indicates are subject to these requirements, based on the results of your visibility modeling analyses. We understand that the SIP-approval process involves the opportunity for review and comment from Federal Land Managers, other interested stakeholders, and the public, and we may subsequently revise the write-up based on comments received before the SIP is submitted to EPA.

Finally, we would like to express our appreciation to your staff for working with us on this project. In particular, we would like to acknowledge the assistance of Christine Suarez-Murias. We look forward to continuing to work together as the SIP process is finalized.

If you have any questions regarding this letter, please contact Brian Bateman, the District's Director of Engineering, at (415) 749-4653.

Sincerely,

Jack P. Broadbent
Executive Officer/APCO

Enclosure

cc: Karen Magliano, CARB Air Quality Data Branch Chief

This page intentionally left blank.

Summary of Bay Area Air Quality Management District Best Available Retrofit Technology Determinations

By:

Brenda Cabral

Bay Area Air Quality Management District

December 2, 2008

Modeling was performed for the Best Available Retrofit Technology (BART)-eligible sources by the California Air Resources Board (CARB) at the following six facilities in the San Francisco Bay Area:

Chevron Richmond Refinery
ConocoPhillips Rodeo Refinery
Rhodia Martinez Sulfuric Acid Plant
Shell-Martinez Refinery
Tesoro-Avon Refinery
Valero-Benicia Refinery

Of these, only the Valero Benicia Refinery (Valero) had an impact on visibility that was over 0.5 deciview and therefore high enough pursuant to the Regional Haze regulations in 40 CFR 51, Subpart P, Protection of Visibility, to require a BART determination.

The following BART-eligible sources at Valero were included in the modeling: the "Main Stack," a hydrogen plant reformer furnace, four turbine/boiler sets, two Claus units, and a cooling tower. The refinery flares were not included in the modeling because refinery flares in the Bay Area are used only for startup, shutdown, upset and malfunction.

The table below summarizes the BART determinations for the Valero sources.

Proposed BART Determinations for Valero

Unit	NOx Control Type	NOx Emission Limit	SO2 Control Type	SO2 Emission Limit	Particulate Type and Limit
"Main Stack:" Valero Coker, FCCU, CO Boilers (Units S3, S4, S5, S6)	SCR	50 ppm on 365-day basis (est. annual emissions: 611 tpy)	CANSOLV regenerative amine scrubber (SO2 removal) with BELCO pre-scrubber (PM10 and SO3 removal)	50 ppm SO2 @ 0% O2 on a 7-day average basis, 25 ppm SO2 @ 0% O2 on a 365 day basis (est. annual emissions: 416 tpy)	Scrubber: 116 tpy
Valero Reformer Furnace (S21); (S21 or S22 may be replaced with S1061)	Low NOx burners	0.033 lb/MMbtu on a refinery-wide basis; 60 ppmdv @ 3% O2, 24-hr average	Sulfur removal from fuel gas using amine stripping	51 ppm total reduced sulfur (TRS) in refinery fuel gas on a rolling consecutive 365-day average, 100 ppm TRS on a rolling 24-hr average	Use of gaseous fuel

Proposed BART Determinations for Valero

Unit	NOx Control Type	NOx Emission Limit	SO2 Control Type	SO2 Emission Limit	Particulate Type and Limit
Valero Reformer Furnace (S22); S21 or S22 may be replaced with S1061	Low NOx burners	0.033 lb/MMbtu on a refinery-wide basis; 60 ppmdv @ 3% O2, 24-hr average	Sulfur removal from fuel gas using amine stripping	51 ppm TRS in refinery fuel gas on a rolling consecutive 365-day average, 100 ppm TRS on a rolling 24-hr average	Use of gaseous fuel
Valero S43, Turbine (associated w/S56, Waste Heat Boiler)	Water injection	55 ppm @ 15% O2 (no additional control)	Sulfur removal from fuel gas using amine stripping	51 ppm TRS in refinery fuel gas on a rolling 4 quarter basis	Use of gaseous fuel; 7 tpy
Valero S44, Turbine (Associated with S36, Waste Heat Boiler)	Water injection	55 ppm @ 15% O2 (no additional control)	Sulfur removal from fuel gas using amine stripping	51 ppm TRS in refinery fuel gas on a rolling 4 quarter basis	Use of gaseous fuel; 8 tpy
Valero S45, Turbine, S37, Waste Heat Boiler	SCR	9 ppm @ 15% O2; 28 tpy (no additional control)	Sulfur removal from fuel gas using amine stripping	51 ppm TRS in refinery fuel gas on a rolling 4 quarter basis	Use of gaseous fuel; 12 tpy
Valero S46, Turbine (Associated w/S48, Waste Heat Boiler)	Water injection	55 ppm @ 15% O2 (no additional control)	Sulfur removal from fuel gas using amine stripping	51 ppm TRS in refinery fuel gas on a rolling 4 quarter basis	Use of gaseous fuel; 5 tpy

Proposed BART Determinations for Valero

Unit	NOx Control Type	NOx Emission Limit	SO2 Control Type	SO2 Emission Limit	Particulate Type and Limit
Valero S56, Waste Heat Boiler (associated w/S43, Turbine)	No additional controls	55 ppm @ 15% O2	Sulfur removal from fuel gas using amine stripping	51 ppm TRS in refinery fuel gas on a rolling 4 quarter basis	Use of gaseous fuel; 2 tpy
Valero S36, Waste Heat Boiler (associated w/S44, Turbine)	No additional controls	55 ppm @ 15% O2	Sulfur removal from fuel gas using amine stripping	51 ppm TRS in refinery fuel gas on a rolling 4 quarter basis	Use of gaseous fuel; 3 tpy
Valero S48, Waste Heat Boiler (associated w/S46, Turbine)	No additional controls	55 ppm @ 15% O2	Sulfur removal from fuel gas using amine stripping	51 ppm TRS in refinery fuel gas on a rolling 4 quarter basis	Use of gaseous fuel; 3 tpy
S1, S2, Claus Units	No additional controls		No additional controls		No additional controls
S29, Cooling Tower					No additional controls

A discussion of the technological feasibility and cost effectiveness of the controls, and other considerations required by 40 CFR 51, Subpart P, is presented below, organized by source.

<u>1. “Main Stack”</u>

<u>A. Discussion of controls and technological feasibility</u>

The fluidized coker, the fluidized catalytic cracker unit or FCCU, and two CO boilers are vented to the “Main Stack.” The current potential to emit for the Main Stack is:

SO2: 6,222 tons per year (tpy)
NOx: 756 tpy
PM10: 179 tpy

Valero is under a consent decree that requires control of SO2 from the main stack. This reduction will be completed by the 2012 BART deadline. Valero has submitted Application No. 16937 to incorporate this requirement into its District permit. The District's evaluation of this application is close to completion as of November 5, 2008. The consent decree also specifies that the requirement for control has to be incorporated into Valero's Title V permit. The requirement is expected to be incorporated into the Title V permit during the renewal, which should be issued by December 1, 2009.

In order to install the SO2 control, Valero had to replace the existing CO boilers (S5 and S6). The new CO boilers are subject to Best Available Control Technology for NOx.

After the controls are installed, the emissions will be:

SO2: 416 tpy
NOx: 611 tpy
PM10: 106.5 tpy

SO2 will be controlled by use of a regenerative amine scrubber for SO2 removal and a BELCO pre-scrubber for PM10 and SO3 removal. The SO2 will be sent to a sulfur recovery unit, resulting in about 2,900 tpy of additional sulfur recovery.

The use of a regenerative amine scrubber is preferable to a caustic scrubber for SO2 control because a caustic scrubber would use a large amount of water and generate an additional waste stream.

PM10 is currently controlled with an electrostatic precipitator. Use of the scrubber will result in lower PM10 emissions than use of the electrostatic precipitator in this case. The annual emission rate will be limited by a permit condition and monitored with an annual source test.

NOx is currently controlled with non-selective catalytic reduction (NSCR). After the SO2 scrubber is installed, NOx will be controlled by use of selective catalytic reduction (SCR) at the main stack and by use of low NOx burners at the CO boilers. Additional control of NOx by SCR is not feasible because the stream contains a high concentration of sulfur at the point where the SCR will be installed. The SCR cannot be installed downstream of the SO2 scrubber because the SCR must run at a higher temperature than the SO2 scrubber.

The improvements at the Main Stack will result in a 0.476 deciview improvement at Point Reyes on the eighth highest day per CalPuff modeling by CARB. The cost of the improvement is $202 million/deciview/yr.

Use of scrubbers for SO2 and PM10 and SCR for NOx is considered to be the highest practical level of control available. Therefore, lesser controls were not evaluated. This level of control will be far superior to the NSCR and electrostatic precipitator that are currently installed.

B. Costs of compliance

The capital cost for the scrubbers is estimated to be $413 million, and the annual operating costs will be $7 million, for a total annual cost of $80 million. Based on reductions of 5806 tpy SO2 and 72.5 tpy PM10, the cost/ton of reductions is $11,780, which is above any reasonable BART threshold for cost-effectiveness.

NOx will be controlled by use of SCR at the Main Stack and by use of low NOx burners at the CO boilers.

The capital cost for the SCR will be approximately $110 million, and the annual operating costs will be $1.5 million, for a total annual cost of $16.5 million.

NOx is currently controlled by NSCR. The amount of NOx currently generated before control is estimated at 1,466 tpy. The limit after installation of the SCR will be 600 tpy. Using a reduction of 866 tpy NOx to calculate cost-effectiveness, the cost/ton is $20,760. Using the incremental reduction of 156 tpy NOx, the incremental cost-effectiveness is $115, 240. The costs of NOx control at this stack are above any reasonable BART threshold for cost-effectiveness.

These estimates are based on an interest rate of 7% and an equipment life of 15 years, as suggested by the EPA Concost manual.

C. Energy and non-air quality environmental impacts of compliance

A non-air quality related impact of SCR is the risk associated with the transport of ammonia for use in the SCR. The cost of ammonia for SCR is included in the cost estimate. In this case, the amount of ammonia emitted will go down by approximately 346 tons/yr because the ammonia slip will be more tightly controlled. Therefore, the number of ammonia shipments to the facility will be reduced.

The use of a regenerative amine scrubber is preferable to a caustic scrubber for SO2 control because a caustic scrubber would use a large amount of water and generate an additional waste stream.

The CO boilers will have to be replaced due to the installation of the SO2 scrubber because the system will operate at a higher pressure than the CO boilers' design pressure.

D. Any existing pollution control technology in use at the source
NSCR currently controls an estimated 1,022 tons NOx/yr at the Main Stack. An electrostatic precipitator controls particulate matter. There are no existing SO2 controls. The proposed controls will be superior to the existing controls.

E. The remaining useful life of the source
None of Bay Area BART-eligible sources are expected to be retired over the next twenty years. Therefore, this factor did not affect any of the District's BART determinations. The cost-effectiveness calculations were based on a 15-year amortization period, as suggested by the EPA OAQPS Control Cost Manual.

F. The degree of visibility improvement that may reasonably be anticipated from the use of BART
The visibility improvement that will result from the proposed reductions in SO2, NOx, and PM10 at the Main Stack will be 0.476 deciview at Point Reyes on the eighth highest day per CalPuff modeling by CARB. The modeling for the BART-eligible sources at this facility originally showed a maximum visibility impact of 0.758 deciview. The resulting visibility impairment is 0.282 deciview.

This improvement would drop the facility below the 0.5 deciview threshold in Appendix Y to 40 CFR 51, Subpart P, where a source is considered to contribute significantly to visibility impairment.

G. Conclusion
The controls on the "Main Stack" sources that are included in the consent decree are considered to be the highest practical level that is technologically achievable. Although the controls exceed reasonable thresholds for BART cost effectiveness, the resulting emission reductions are significant, as is the potential improvement in visibility at Point Reyes. These controls are therefore deemed to be adequate for meeting BART requirements.

2. Hydrogen Plant Reformer Furnaces (S21 and S22)

The capacity of the reformer furnaces is 614 MMbtu/hr furnaces each. S21 or S22 may be replaced in the next four years with a 984 MMbtu/hr furnace, depending on the economics of the project. The new furnace would be subject to BACT for NOx, PM10, and SO2. If the furnace were replaced, reductions of NOx and PM10 of 70 tpy and 9 tpy, and an increase of 10 tpy SO2 would be anticipated. An application has been submitted to replace one of the reformer furnaces, but the project may not be built.

The BART discussion below is based on the existing equipment and assumes that one of the furnaces will not be replaced.

A. Discussion of controls and technological feasibility
PM10 is controlled by the use of gaseous fuel.

SO2 is controlled by the use of low-sulfur refinery fuel gas. Hydrogen sulfide in the gas is scrubbed by amine stripping and converted to elemental sulfur in the sulfur recovery units. The furnaces have a limit of TRS in fuel of 51 ppm on a rolling consecutive 365-day average and 100 ppm TRS on a rolling 24-hr average. This limit is close to the 45-ppm BACT limit that is imposed on new sources.

NOx at the reformer furnaces is controlled by low NOx burners. Valero operates under a federal consent decree that requires control of NOx from most boilers and furnaces at the facility, including the reformer furnaces. The limit is 0.033 lb NOx/MMbtu on a refinery-wide basis. The reformer furnaces also have a short-term limit of 60 ppmv NOx @ 3% O2 averaged over 24 hours, which is roughly equivalent to 0.076 lb/MMbtu. The actual emissions are about 0.036 lb NOx/MMbtu on an annual basis.

The controls above are existing controls. No further reductions are planned.

It is feasible to control additional NOx at the furnaces with SCR, but additional control would not necessarily result in facility-wide NOx emission reductions, because the consent decree limit is on a refinery-wide basis. Additional control at the reformer furnaces would allow higher emissions at other refinery heaters or boilers. The refinery generally emits most of the NOx allowed on a daily basis. Any excess emissions are managed with the use of interchangeable emission reduction credits (IERC), which is allowed by the consent decree.

If controlled with SCR, concentrations of 10 ppmv NOx @ 3% O2 (equivalent to 0.012 lb/MMbtu) might be achievable.

B. Costs of compliance

No additional costs will be incurred for the existing controls.

If SCR were required for the furnaces, the cost/ton can be estimated at $14,000/ton. This estimate is derived from Table 13, “Cost Effectiveness Data for Boilers Rated at 200 MMbtu/hr” in the California Air Resources Board’s (CARB’s) “Report to the Legislature: Implications of Future Oxides of Nitrogen Controls From Seasonal Sources in the San Joaquin Valley.”

During the years 2005-2008, the actual emissions were about 126 tons NOx/yr total. A reduction of 56 tpy NOx could cost about $784,000 per year.

C. Energy and non-air quality environmental impacts of compliance

A non-air quality related impact of SCR would be the risk associated with the transport of ammonia for use in the SCR. The risk would be considered insignificant because the refinery already imports ammonia for use in other SCR units at the facility.

D. Any existing pollution control technology in use at the source

As described above, the furnaces are currently controlled with low-NOx burners, use of gaseous fuel, and use of low-sulfur refinery fuel gas.

E. The remaining useful life of the source

According to the plant contacts, none of Valero BART sources are expected to retire over the next twenty years. Therefore, this factor did not affect any of the District's BART determinations.

F. The degree of visibility improvement that may reasonably be anticipated from the use of BART

No additional visibility improvement is expected from the existing controls.

No additional visibility improvement would be anticipated from additional control of NOx at the furnaces because a decrease in NOx at the furnaces could be offsets by an increase at another source.

The actual emissions are about 63 tons NOX/yr each (based on a 3-year baseline calculated for Application 16937) for a total of 126 tpy NOx. If the sources were controlled by SCR, a reasonable concentration limit would be 10 ppmv @ 3% O2 or 0.013 lb/MMbtu. The furnaces would be allowed to emit about 70 ton NOx/yr total, for a reduction of 56 tpy NOx.

A hypothetical reduction of 268 tons NOx/yr was modeled by CARB for the turbine/boiler sets. The hypothetical improvement in visibility would have been 0.091 deciview. If the improvement in visibility were proportional, the improvement obtained by further controlling the furnaces would be 0.019 deciview, which is too small to make these controls reasonable.

A 56-tpy reduction in NOx at the reformer furnaces has not been included in the model as of December 2, 2009, so the above estimate of the visibility improvement is an approximation. The stack heights for the reformer furnaces are about 250 feet and the stack heights for the turbine/boiler sets are between 60 and 80 feet. The exit velocities for the boiler/turbine sets are about twice as high as the exit velocities for the furnaces. The exit temperatures are similar. Modeling would have to be performed to determine the magnitude of an improvement achievable by a 56-tpy reduction in NOx, but it is likely to be insignificant.

G. Conclusion

No further controls are proposed because additional controls would provide an insignificant amount of visibility improvement.

3. Turbine/Boiler Sets

A. Discussion of controls and technological feasibility

Valero has four turbine/boiler sets that were installed in 1969. The emissions of SO_2 are low because the sources use low-sulfur fuel. They will be subject to a 51-ppm limit on TRS in fuel. The combined potential to emit for SO_2 is 15 tpy. NO_x at the largest set is controlled by SCR to 9 ppmv @ 15% O_2. The combined NO_x emissions of the remaining three sets are about 341 tpy.

These turbine/boiler sets are different than most turbine/duct burner sets because the boilers have their own air source and can be fired separately from the turbines. Duct burners cannot be fired when the turbines are not operated.

CARB modeled a hypothetical reduction for these sources to 73 tpy NO_x, which is equivalent to a 10 ppmv NO_x concentration achievable by SCR. The modeling result for the hypothetical reduction was 0.091 deciview, which is an insignificant improvement. BAAQMD is not proposing SCR because it is not cost-effective.

NSCR is not feasible due to the cycling nature of the operation. Valero uses other more efficient sources of steam first, then these sources, so these sources are not always in use and the load is variable when they are in use. The operation is not stable enough to ensure that the temperature at an ammonia or urea injection site will be in the right range for NSCR to operate.

Low NO_x burners were also considered, but low NO_x burners are not available for turbines in this size range (8.9 MW), and are not feasible at the boilers because they operate at a very high turndown (the boilers are used at about 25% of capacity). The refinery operates more efficient sources of steam at the facility whenever possible.

Even if low NO_x burners were feasible at the boilers, the visibility improvement at Point Reyes would be extremely low. The boilers use only about 38% of the fuel burned by the system, based on 2007 data. Assuming that 130 tpy NO_x is attributable to the boilers, and that the low NO_x burners would reduce emissions from 40 ppmv to 30 ppmv, a reduction of only 32 tpy would result, which would be roughly equivalent to 0.01 deciview, an insignificant reduction.

Water injection is already being used at the turbines to lower NO_x. The turbine/boiler sets are subject to BAAQMD Regulation 9, Rule 9, which imposes a 55 ppmv @ 15% O_2 limit for NO_x. The sources currently operate at around 40 ppmv NO_x @ 15% O_2, which is about 0.15 lb NO_x/MMbtu.

B. Costs of compliance

BAAQMD proposes no additional control for the three turbine/boiler sets (S43/S56, S44/S36, S46/S48).

BAAQMD determined the cost-effectiveness for SCR based on recent rule development data and determined that the estimated cost is between $5000 and $7000/ton, which is above reasonable thresholds for BART cost-effectiveness. The energy usage is included in this estimate

NSCR and low-NOx burners were determined not to be feasible at these sources because no low-NOx burners are available for the Frame Size 3 turbines.

NOx emissions at the turbines are controlled by water injection.

C. Energy and non-air quality environmental impacts of compliance

A non-air quality related impact of SCR or NSCR would be the risk associated with the transport of ammonia for use in the SCR or NSCR. The risk would be considered insignificant because the refinery already imports ammonia for use in other SCRs at the facility.

D. Any existing pollution control technology in use at the source

NOx is controlled at one turbine/boiler set (S37/S45) with SCR.

NOx is controlled at the other three turbine/boiler sets by use of water injection. The existing NOx limit in BAAQMD Regulation 9, Rule 9, for these turbines is 55 ppmvd @ 15% O_2. In 2010, the limits will be to 50 ppmvd @ 15% O_2. The turbine/boiler sets currently operate between 40 and 46 ppmvd @ 15% O_2.

SO_2 and PM10 emissions are controlled at all four turbine/boiler sets by use of low-sulfur refinery fuel gas. The TRS limit for the refinery fuel gas will be 51 ppm on an annual basis.

E. The remaining useful life of the source

According to the plant contacts, none of Bay Area BART sources are expected to retire over the next twenty years. Therefore, this factor did not affect any of the District's BART determinations. The cost-effectiveness calculations were based on a 15-year amortization period, as suggested by the EPA OAQPS Control Cost Manual.

F. The degree of visibility improvement that may reasonably be anticipated from the use of BART

CARB modeled a hypothetical reduction for these sources from 503 to 73 tpy NOx, which is equivalent to a 10 ppmv NOx concentration achievable by SCR. The modeling result for the hypothetical reduction was 0.091 deciview, which is an insignificant improvement.

G: Conclusion

No further controls are proposed because additional controls are either not cost-effective or would provide an insignificant amount of visibility improvement.

4. Claus Units

A. Discussion of controls and technological feasibility

The potential to emit for the Claus units is about 1 tpy NOx. They have no SO2 or PM10 emissions.

B. Any existing pollution control technology in use at the source

The Claus units are controlled by use of a reduction control system, which results in a very low potential to emit for SO2.

C. Conclusion

No further controls are proposed because the emissions are very low.

5. Cooling Tower

A. Discussion of controls and technological feasibility

The calculated potential to emit for the cooling tower based on AP-42 chapter 13.4 is about 41 tpy PM10. The calculation method has an “E” rating. It is estimated that the PM10 emissions may be overstated by an order of magnitude.

B. Conclusion

No further controls are proposed since the emissions are very low.